# *Instruction Manual*

# *Model 318*

## HIGH VOLTAGE

## POWER SUPPLY

INSTRUMENT
CENTE

**Baird-Atomic, Inc.**

33 UNIVERSITY ROAD • CAMBRIDGE 38, MASS.

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## NOTE

While this manual was written for the Model 318, it applies equally to the Model 318A. The differences between the instruments are confined to layout of components and front panel dimensions.

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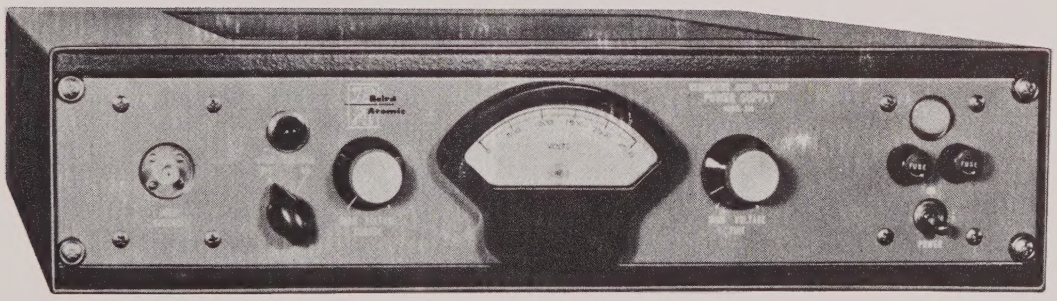
## POWER SUPPLY



**Baird-Atomic, Inc.**

33 University Road, Cambridge 38, Massachusetts

# MODEL 318 HIGH VOLTAGE POWER SUPPLY

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# MODEL 318 HIGH VOLTAGE POWER SUPPLY

## WARNING

Voltages as high as 4000 volts exist within this equipment. Contact with such voltage may prove fatal. EXTREME CAUTION should be exercised if the high-voltage chassis (left side) is operated without its protective cover screen. All high-voltage capacitors should be discharged prior to working on interior parts of this unit.

## SECTION I
## GENERAL DESCRIPTION

Model 318 supplies a stabilized d-c voltage which is continuously variable between 500 and 2500 volts.

The Model 318 contains a high-voltage chassis with a high-voltage adjustment and metering circuit and an on-off switch and pilot lamp. It consists of a delay circuit to prevent output voltage overshoot when the equipment is turned on, a half-wave rectifier, and an electronic voltage regulator. There is also a low-voltage chassis which supplies +300V and 6.3V AC to the high-voltage chassis.

Physically, Model 318 consists of modular left-side (high voltage) and right-side (low voltage) chassis assemblies and a front panel mounted in a bottom- and top-ventilated cabinet. The front panel carries the voltage-indicating meter and all necessary operating controls. Table I lists its principal electrical characteristics.

## TABLE I. OPERATING SPECIFICATIONS

| | |
|---|---|
| Receptacle: | High Voltage MHV (JK-1) |
| Range: | 500-2500V, positive output, continuously variable by adjustment of "coarse" and "fine" controls. |
| Maximum Load: | 1800 microamps at 500V, 1000 microamps at 1500V, and 250 microamps at 2500V. |
| Load Regulation: | Output voltage decrease is less than 0.160% at 500V, 0.036% at 1500V and 0.008% at 2500V for a 10% current increase at maximum load. |
| Line Regulation: | Change in output voltage per volt input voltage change from 105 to 125V is less than 0.006% at 500V, 0.0026% at 1500V and 0.0027% at 2500V. |
| Stability: | Approximately 0.2% output voltage change per day. |
| Ripple: | Less than 0.15V peak-to-peak. |
| Time Delay: | To prevent overshoot when turned on. |
| Power Requirements: | 105V to 125V AC, 60-cycle at 0.6 amps (115V, 50 cycles or 220V, 50 cycles also available). |

## SECTION II
## INSTALLATION

Figure 1 gives front panel dimensions which will aid in planning an installation. After unpacking, remove the equipment from its cabinet, inspect for shipping damage, and clean out all foreign matter. It may be removed from its cabinet and mounted in a standard 19-inch relay rack. Baird-Atomic instruments have a unique "chimney" construction which reduces the operating temperatures by free-flow ventilation and permits ready access to all parts of the instrument. Therefore, if mounting in a rack, be certain that there are no top-to-bottom obstructions to the free flow of air.

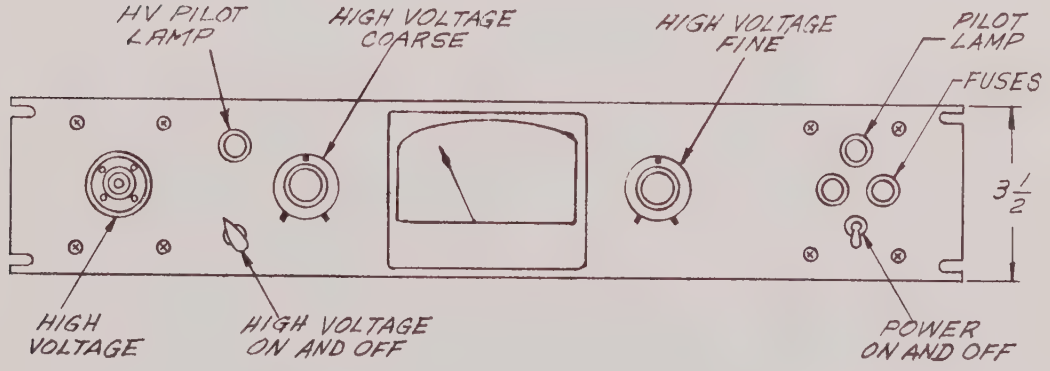



Figure 1 - Front Panel

## SECTION III
## OPERATION

a. Turn the POWER Switch to ON. The indicator lamp (white) should light.

b. Turn the HIGH VOLTAGE COARSE and HIGH VOLTAGE FINE Controls fully counterclockwise.

c. Turn the HIGH VOLTAGE Switch to ON. The indicator lamp (red) should light. Voltage should appear at the HIGH VOLTAGE Connector about 30 seconds after closure of the POWER Switch.

NOTE

Turning the HIGH VOLTAGE Switch to OFF removes voltage from the HIGH VOLTAGE Connector and meter circuit without shutting off line power. Thus this control functions as a stand-by switch.

d. Adjust the HIGH VOLTAGE COARSE and FINE Controls for the desired regulated output voltage (between +500 and +2500V) as indicated by the meter.

## SECTION IV
## THEORY OF OPERATION

High-Voltage Chassis. The high-voltage chassis consists of a half-wave rectifier followed by an electronic shunt-type voltage-regulating circuit. The regulating circuit prevents variation of the output voltage when either the line voltage or the load current varies, and it suppresses the ripple content of the d-c voltage at the rectifier output.

When POWER Switch S101 is turned ON, the heater of thermal switch V5 is energized. To prevent overshoot of the high voltage, V5 has a delay of 30 seconds before its relay contacts close to excite the primary of step-up transformer T1. In this time, all tubes in the regulating circuit are brought to operating temperature. When sufficient time has elapsed to allow the contacts of thermal switch V5 to close, high-voltage output will still be delayed after turning the HIGH VOLTAGE ON-OFF Switch S1 ON by the time required for V1 to reach operating temperature, a period of several seconds at most. The a-c voltage at the secondary of T1 is converted by V1, a half-wave rectifier, to a pulsating d-c voltage which is developed across storage capacitor C1. This voltage is then stabilized and smoothed by the electronic regulating circuit consisting of tubes V2, V3 and V4.

In the regulator circuit, a fraction of the output voltage, determined by the setting of HIGH VOLTAGE FINE Control R12, is compared against a fraction of the reference voltage developed across reference tube V4, determined by the setting of HIGH VOLTAGE COARSE Control R9. Any incremental difference in the two voltages is amplified by differential amplifier V3 and applied to the grid of shunt-regulator tube V2, the internal impedance of which is made to vary. The sum of the load current and the anode current of regulator tube V2 flows through resistor network R1, R2, R15 and R16 in series with rectifier V1. The internal impedance variation

of regulator tube V2 controls a part of the current flowing through the series resistor network in such a manner that any output voltage variation results in a change in voltage drop across the resistor network which opposes the original output voltage variation.

Should the output voltage increase slightly, the bias at pin 7 of V3, the comparison amplifier, will become more positive, while the bias at pin 2 of this tube stays fixed at the setting of the HIGH VOLTAGE COARSE Control R9. This bias variation is amplified by V3 causing one anode (pin 1) potential to increase. The anode is directly coupled to the grid of regulator tube V2, so that the impedance of V2 will decrease and the increase in anode current through this tube will produce an increase in voltage drop across the series resistor network, causing the output voltage to drop. A decrease in output voltage will result in a reverse action. The time lag in action of the feedback system is very small, and the output voltage is held nearly constant despite variations in input voltage and output current. Output voltage variations due to ripple are coupled by C4 to a grid of differential amplifier V3. The feedback loop gain is greater for power line frequencies than for d-c variations so that ripple is greatly suppressed.

Output voltage is indicated by M1, a 200-microampere meter paralleled for calibration purposes by Rx. Maximum voltage output is determined by calibrating resistor Ry.

Low Voltage Chassis. The low-voltage chassis supplies from 115V AC all operating power requirements of the Model 318. This chassis contains an input-regulating power transformer which stabilizes against line voltage

fluctuations, and a conventional full-wave center-tap rectifier followed by a condenser-input L-C filter. Plate and filament transformer T101 is energized through fuses F101 and F102 when POWER Switch S101 is turned ON. This transformer supplies 6.3V AC regulated heater potential to tubes V2, V3 and thermal switch V5.

Capacitor C101 is essential to the regulating action of T101. Rectifier tube V101 supplies pulsating direct current to a smoothing filter consisting of C102, C103 and L101. The regulated +300V output appears across bleeder resistor R101 and supplies plate voltage through HIGH VOLTAGE ON-OFF Switch S1 to dual triode V3 of the High-Voltage Strip.

## SECTION V
## MAINTENANCE

Loss of regulating action may require replacement of shunt regulator tube V2 and/or comparison amplifier V3. All electrical components are identified by symbol numbers in Figures 2 and 3 for easy location.

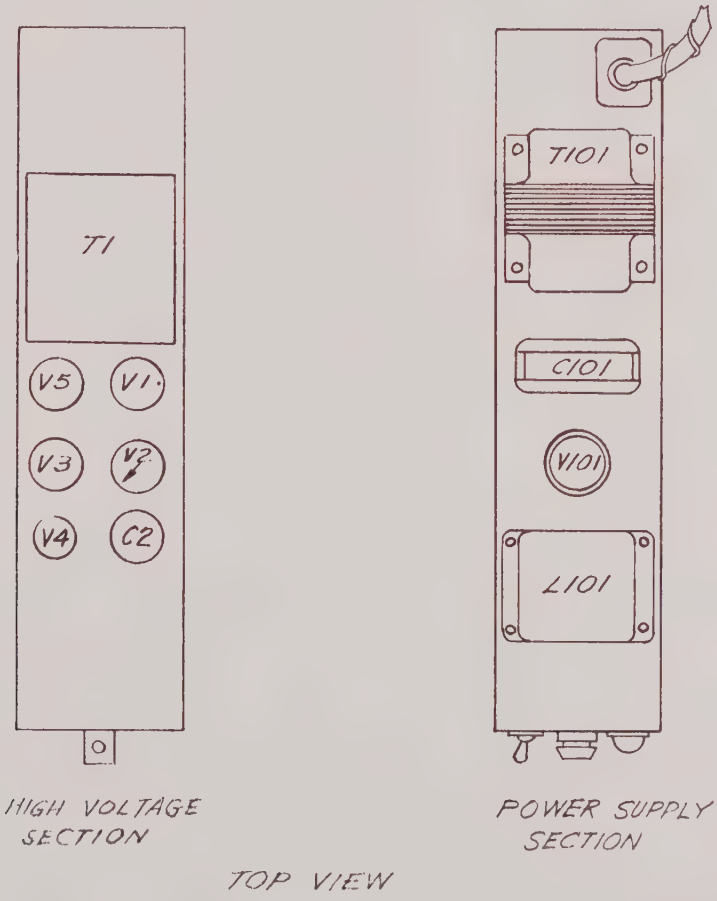



Figure 2 - Component Tube Layout

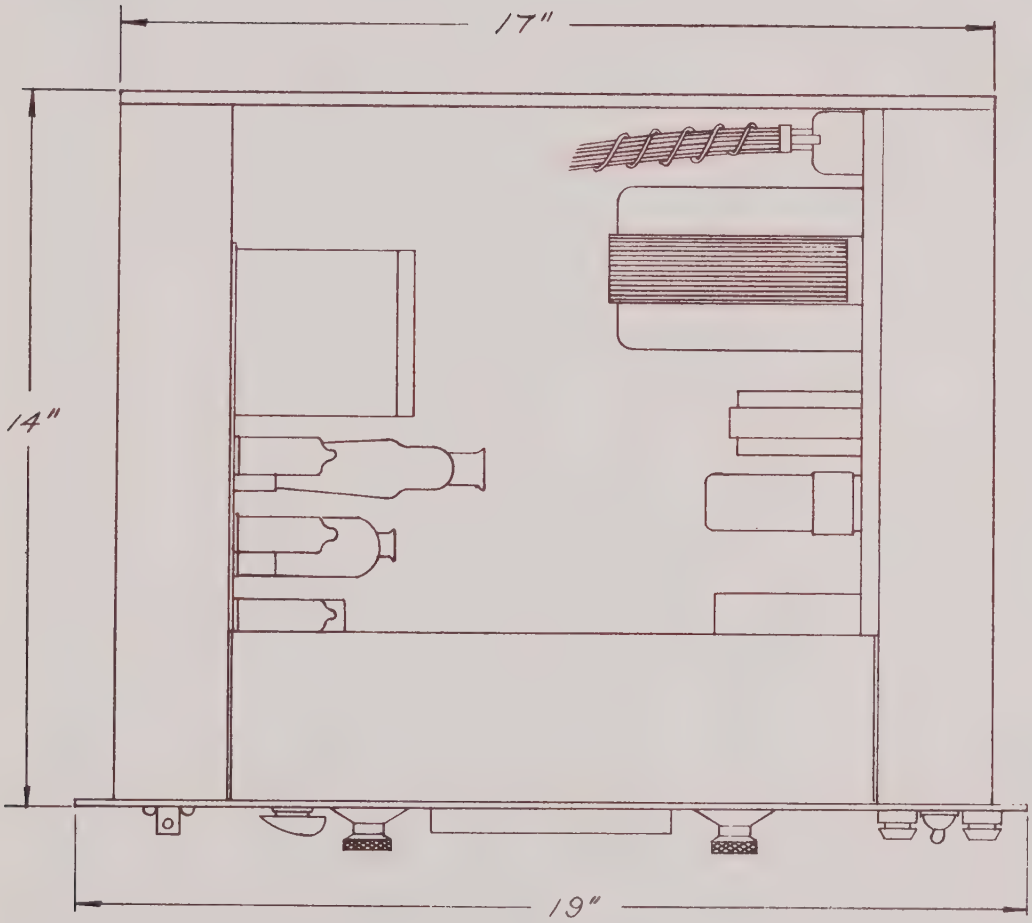



Figure 3 - Top View

# MODEL 318 HIGH VOLTAGE POWER SUPPLY

## SECTION VI

## PARTS LIST

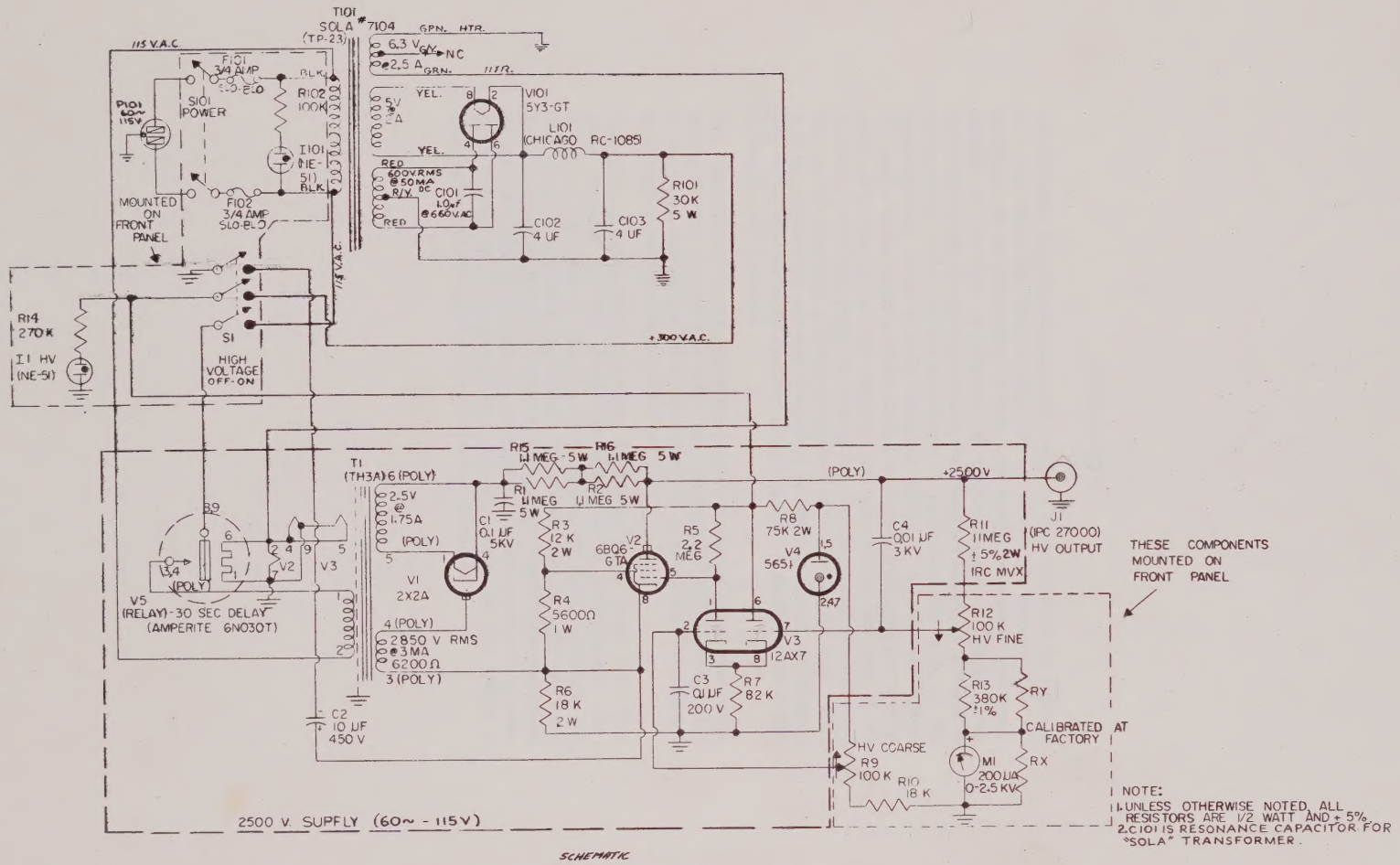
| SYMBOL DESIGNATION | DESCRIPTION | B/A PART NO. |
|---|---|---|
| C1 | 0.1 mf, silicone-filled, 5KV | CP-104-19 |
| C2 | 10 mf, electrolytic, 450V | CE-106-2 |
| C3 | 0.1 mf, paper, 200V | CP-104-10 |
| C4 | 0.01 mf, plastic film, 3KV | CG-103-5 |
| C101 | 1 mf, oil-filled, 660V AC (supplied with T101) | |
| C102 | 4 mf, oil-filled, 330V AC | CP-405-2 |
| C103 | 4 mf, oil-filled, 330V AC | CP-405-2 |
| F101 | 3/4 amp, 125V, 3AG, time delay | FS-16 |
| F102 | 3/4 amp, 125V, 3AG, time delay | FS-16 |
| I1 | Lamp, NE-51 | LA-8 |
| I101 | Lamp, NE-51 | LA-8 |
| J1 | HV coaxial connector | JK-1 |
| J2 | Connector, 8 pin, female | JK-33 |
| J3 | Connector, 8 pin, male | JK-9 |
| L101 | Choke, filter, 10 hy, 85 ma | LF-9 |
| M1 | Meter, 200 μa, 0-2500V full-scale | MT-24A |
| P2 | Connector, 8 pin, male | PL-20 |
| P3 | Connector, 8 pin, female | PL-5 |
| P101 | Line cord and plug | LC-1 |
| R1 | 1.1 meg, 5%, 5W, film type | RF-115-1 |
| R2 | 1.1 meg, 5%, 5W, film type | RF-115-1 |
| R3 | 12K, 5%, 2W, comp | RCH-123J |
| R4 | 5600 ohms, 5%, 1W, comp | RCG-562J |
| R5 | 2.2 meg, 5%, 1/2W, comp | RCE-225J |
| R6 | 18K, 5%, 2W, comp | RCH-183J |
| R7 | 82K, 5%, 1/2W, comp | RCE-823J |
| R8 | 75K, 5%, 2W, comp | RCH-753J |
| R9 | 100K, 10%, 4W, variable, wire wound | RA-104-4 |

## MODEL 318 HIGH VOLTAGE POWER SUPPLY

### PARTS LIST (Cont.)

| SYMBOL DESIGNATION | DESCRIPTION | B/A PART NO. |
|---|---|---|
| R10 | 18K, 5%, 1/2W, comp | RCE-183J |
| R11 | 11 meg, 5%, 2W, film type | RF-116-2 |
| R12 | 100K, 10%, 4W, variable, wire wound | RA-104-4 |
| R13 | 380K, 1%, 1/2W, film type | RF-384-1 |
| R14 | 270K* | |
| R15 | 1.1 meg, 5%, 5W, tilm type | RF-115-1 |
| R16 | 1.1 meg, 5%, 5W, film type | RF-115-1 |
| R101 | 30K, 5%, 5W, wire wound | RW-303-1 |
| R102 | 100K** | |
| Rx | 1/2W, comp, value determined at factory | |
| Ry | 1/2W, comp, value determined at factory | |
| S1 | Rotary, single section, 3PST | SR-12 |
| S101 | DPDT, toggle | ST-1 |
| T1 | Transformer; primary 117V, 50-60 cycle; secondary 2850V at 3 ma, 2.5V at 1.75 amp | TH-3 |
| T101 | Power transformer; primary 100-130V, 60 cycle; secondary 600V center tapped at 50 ma, 5V at 2 amp, 6.3V center tapped at 2.5 amp | TP-23 |
| V1 | 2X2A, half-wave high-vacuum rectifier | 2X2A |
| V2 | 6BQ6-GTA, beam-power amplifier | 6BQ6-GTA |
| V3 | 12AX7, high-mu twin triode | 12AX7 |
| V4 | 5651, voltage reference | 5651 |
| V5 | 30 sec time delay relay, 6.3V AC | RE-2 |
| V101 | 5Y3-GT, full-wave high-vacuum rectifier | 5Y3-GT |

* R14 is built-in pilot lamp assembly; B/A Part No. LA-11
** R102 is built-in pilot lamp assembly; B/A Part No. LA-7




SCHEMATIC

2500V. H.V. POWER SUPPLY
MODEL 318A, 60~, 115 VOLT - BASIC.

C-318-A-1 (60~-115V) BASIC REV. L

## WARRANTY

Baird-Atomic, Inc. (the "Company"), warrants this equipment for a period of 1 year from the date of shipment as follows: it warrants that all equipment of its manufacture is free from defects in material and workmanship at the time of shipment. If within 1 year of shipment any equipment of the Company's manufacture develops defects in material or workmanship under normal conditions of operation, the buyer of the equipment may return it to the Company within 30 days of such failure, for repairs at the expense of the Company, including the expense of shipment, or in the case of any defective part may return such part to the Company which will repair or replace the same at its expense, including the cost of shipment. A further warranty of 1 year on the same terms shall be applicable to any part so repaired or replaced. Except for Dekatron glow tubes, this warranty does not extend to stock components not manufactured by the Company.

The Company shall not be liable for damage or destruction of instruments during delivery or caused by other than employees of Baird-Atomic, Inc.; in any event, liability shall not exceed the cost of replacement of defective parts upon prompt notification of such defect.

For return of equipment or any part thereof under the terms of the foregoing warranty a letter should be forwarded to Baird-Atomic, Inc., Attention: Sales Service Department, 33 University Road, Cambridge 38, Massachusetts. It should state owner's name and address; model and serial number of the equipment; the order number, under which it was purchased; the date of failure and a description of the circumstances surrounding same. Upon receipt of such information, shipping instructions for return of equipment or parts thereof will be forwarded promptly.

**Baird-Atomic, Inc.**
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91734